Harnessing the Slow Light in Photonic Crystal Waveguides

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Photonic crystals (PhC) are often touted as a powerful system for being able to mold light on the wavelength scale and hence are a strong contender for enabling on-chip optical integration. Perhaps the most interesting property of PhC, however, is their unique dispersive behavior that has implications for broad range of possible applications as dispersion compensators, optical buffers and optical memory. The ability to structurally engineer the dispersion in photonic crystals (PhC) and relatively wide bandwidth response make photonic crystals a promising system to explore this strongly dispersive regime when the group velocity of light is significantly reduced.

We will review progress in exploration of slow light phenomena in membrane-type SOI photonic crystal waveguides. Coupling issues, both off-chip and coupling to the slow group velocity mode in the PhC waveguide, will be discussed. We experimentally demonstrate an over 300-fold reduction of the group velocity in silicon photonic crystal waveguide using integrated Mach-Zehnder interferometer. We show fast (100ns) and efficient (2mW electric power) active control of the group velocity dispersion by localized heating of the photonic crystal waveguide with an integrated micro-heater.

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